

ATTACHMENT 6

VE20-051

PLUG-IN HYBRID RETROFIT



**Massachusetts Bay
Transportation Authority**

Plug-in Hybrid Retrofit (Option 5)

In order to reduce their carbon footprint, the Authority wishes to take advantage of the latest in battery development and hybrid systems technology with the retrofit/conversion of the 60 forty-foot Hybrid bus fleet to Plug-in Hybrid (PHEV).

The bus shall meet all performance standards, design criteria, and configuration validation requirements, as outlined in this Technical Specification.

The Contractor shall work closely and forge a relationship with the bus manufacturer, existing hybrid drive system OEM, and other component OEMs, to optimize systems' efficiencies while developing strategies for weight control and fitment to the existing bus structure and meet PHEV bus performance requirements.

The PHEV bus shall meet the following minimum performance requirements:

1. Bus operation in full electric mode (powered off upgraded Energy Storage System) for no less than 3 engine-off continuous miles based upon Manhattan duty cycle and the bus operating with a full electric load
2. Shall be equipped for daily depot charging to include:
 - a. Bus streetside and curbside rear-mounted plug-in receptacles (using the latest MBTA standard receptacles/infrastructure)
 - b. Automatic bus interlock system to prevent engine run, and bus movement, while in depot charge mode

The Contractor shall also meet the following requirements:

1. Retrofit shall not adversely affect OEM structural and component OEM warranties
2. Provide an appropriate artificial sound generator automatically activated when the bus is in engine off zero-emissions operation mode. Contractor shall demonstrate the artificial sound generator and document the exterior vehicle noise (pull away and approach) when the bus is operating in zero emissions mode
3. PHEV bus shall meet all FMVSS, State, and local regulations
4. Upgraded Energy Storage System and associated components shall be designed to meet all performance requirements for up to 6 years

As part of the Design Review Process, the Contractor shall provide:

1. Provide a cost/benefit/technical analysis of incremental increase of engine off continuous miles between engine run cycles
2. Analysis of engine run time required to return ESS to sufficient state of charge to meet continuous engine off distance requirement
3. Analysis of ESS recharge time utilizing plug-in charging
4. Proposed PHEV bus ESS life expectancy
5. Full documentation including electrical and mechanical drawings, design and configuration calculations, and complete bill of materials

The Pilot Bus and four (4) serial production buses shall be outfitted with data loggers designed to monitor bus performance, provide fault detection, monitor major system components, and retain timestamped data. The system must be able to monitor major system component cycling and operating conditions and be capable of providing data in a format useful for component life cycle analysis.

The Contractor and propulsion system supplier shall instrument and monitor these vehicles in revenue service and provide analysis assistance and monthly reports, or as requested by the Authority. Each vehicle shall be monitored for a minimum period of 6 years.

The Contractor shall be responsible for performing validation testing at their facility as part of the Pilot Bus program. The Contractor will provide technical support to perform on-route testing in the MBTA service area for a minimum of one month following the return of the Pilot bus to the Authority.